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Rock Science



by Steve Voynick

Beryllium: From Lightbulbs to Bicycles

The beautiful beryl gemstones—emerald, aquamarine, morganite, heliodor and goshenite—might not seem to have much in common with \$10,000 racing bicycles. But there is indeed a link: the element beryllium. Beryl is beryllium aluminum silicate, and state-of-the-art racing-bicycle frames are made of beryllium.

Beryllium is as fascinating metallurgically as beryl is gemologically. For openers, beryllium is the second lightest metal (only lithium is lighter). Although beryllium has only one-third the weight of aluminum, it's six times stiffer than steel. In an age in which strong, lightweight metals are needed in everything from racing bicycles to spacecraft, beryllium is a material scientist's dream.

French chemist Louis-Nicolas Vauquelin identified beryllium as an elemental component of beryl in 1798. Vauquelin named the new element "glucenium," because its salts tasted sugary. Thirty years later, researchers isolated a tiny amount of "glucenium," renaming it beryllium. Since the Greek meaning of beryl is "gem," beryllium literally means "gem-metal."

Beryllium remained a laboratory curiosity until 1900, when researchers isolated enough of the metal to study its properties. A gray, brittle metal with a hexagonal structure, beryllium ranks 32nd in crustal abundance, about the same as tin and uranium. Beryllium occurs worldwide, but rarely in concentrated ore deposits.

Until World War II, beryllium had only a few uses. It made fine x-ray windows, since it is transparent to x-rays. And beryllium oxide powder was employed in phosphor coatings of fluorescent light tubes. But then physicists discovered that beryllium was a superb, desperately needed neutron shield for nuclear applications. Copper-beryllium alloys were critical to the development of the atomic bomb and later to the development of atomic power.

As beryllium demand jumped, miners sought new sources of the metal. Beryl, which is found in certain granite pegmatites, was then the only known commercial source of beryllium. The ore was opaque, common beryl, which sometimes occurred as well-formed, hexagonal crystals 10 or even 20 feet long. Beryl mining, which boomed from 1940 through the 1950s, also provided many mineral specimens and fine beryl gemstones. Dozens of

mined-out pegmatites still provide modern collectors with nice mineral specimens and an occasional fine beryl gemstone.

In 1958, beryllium was applied to the manufacture of lightweight missile components. By then, domestic beryl deposits, primarily the pegmatites of Maine, Colorado, South Dakota, New Mexico and California, were exhausted, and beryllium supply depended almost entirely on imported Brazilian beryl.

In 1959, a major mineral discovery in western Utah's Topaz-Spor Mountain area transformed the beryllium supply picture. Commercial miners had long worked the area for uranium and fluorspar, and mineral collectors often visited the site to search for specimens of topaz, beryl and garnet. Identification of commercial grades of bertrandite, or beryllium silicate, triggered a beryllium rush of prospecting and claim staking.

Core-drill exploration confirmed the huge Topaz-Spor beryllium deposit to be the world's largest non-beryl beryllium source. When open-pit mining began in 1968, the U.S. immediately became self-sufficient in beryllium. Even after 25 years of mining, ore reserves are estimated to be large enough to last another 60 years.

Beryllium and its alloys are vital to the aviation and aerospace industries. On helicopters, beryllium masts weighing just 6 pounds are stiff enough to support 95 pounds of instrumentation. Beryllium is also used in the space shuttle in everything from window frames to instrument mounts.

Highly polished beryllium is nearly as reflective as silver and gold in the visible spectrum, and even more reflective for infrared. It's become the material of choice for certain space telescopes and optical guidance systems.

Beryllium and its alloys are also used much closer to home. You'll find them in automotive-air-bag impact sensors, advanced supermarket check-out scanners, computer disk drives, and the frames on those \$10,000 racing bicycles. Incidentally, a complete beryllium-alloy bicycle frame, which is stiffer than steel and nearly as strong, weighs only about a pound and a half.

With qualities like that, it's no wonder that materials scientists consider the "gem metal" to be a metallurgical "gem." ☺

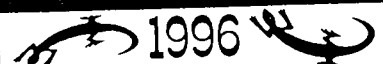


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